

CASE
an eddy-resolving
state estimate of the
California Coastal
System

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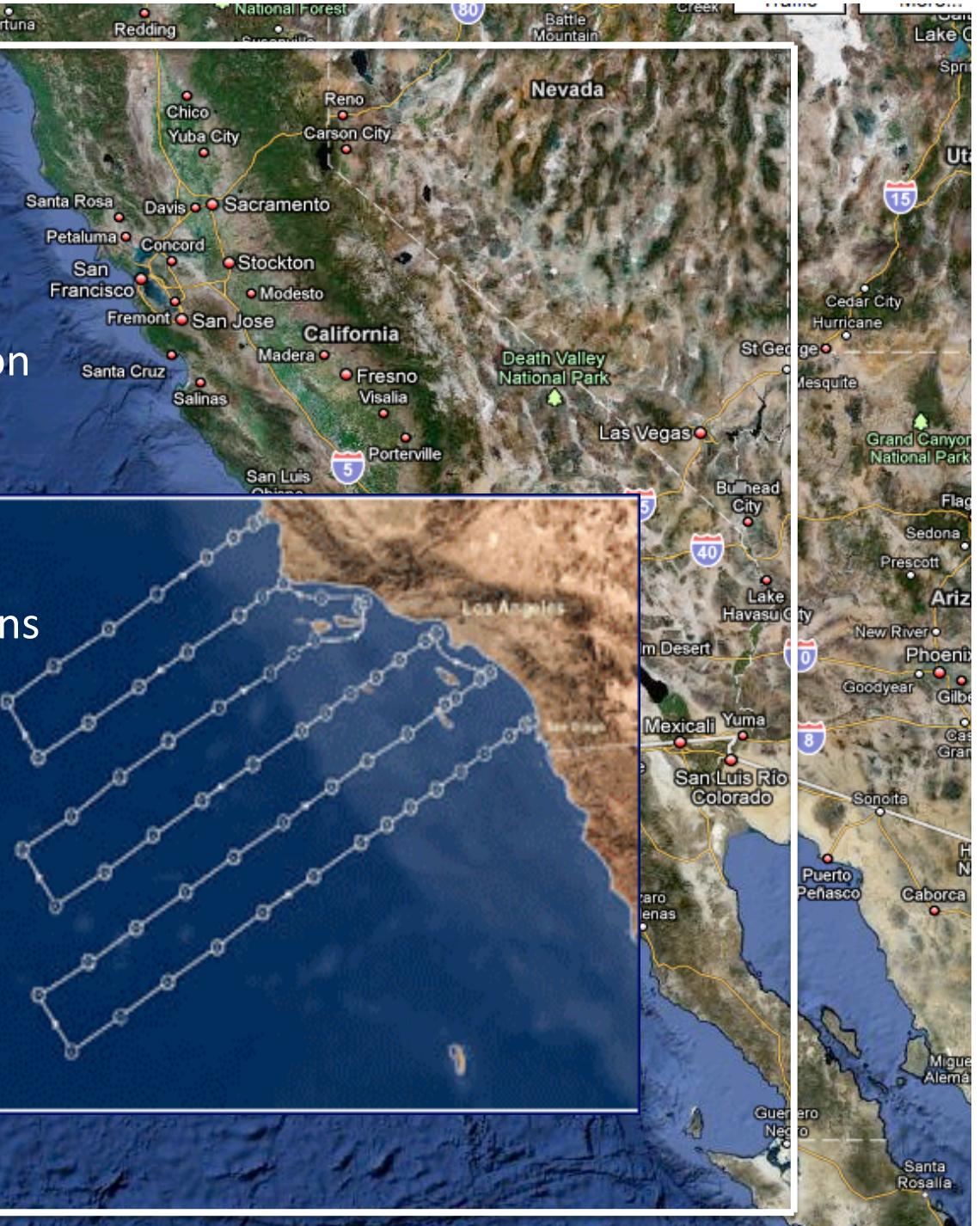
CASE: 1/16° with 72 levels

27.2°N – 40°N, 230°E – coast

A very well observed ocean region
(gliders, moorings, PIES, etc.)

CalCOFI: California Cooperative
Oceanic Fisheries Investigations

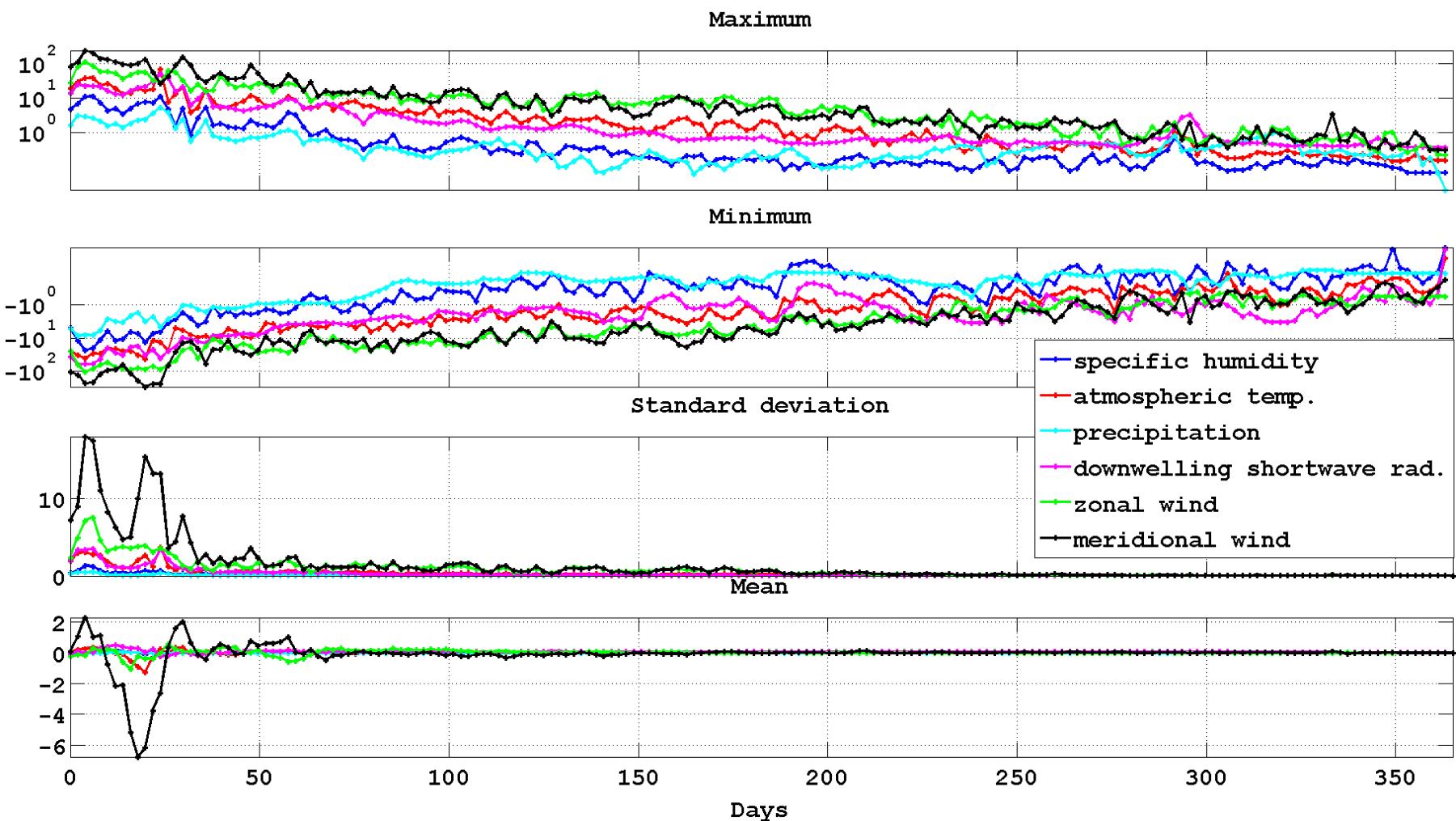
CORC III: Consortium on the
Ocean's Role in Climate:
Integrated Boundary Current
Observations In the Global
Climate System



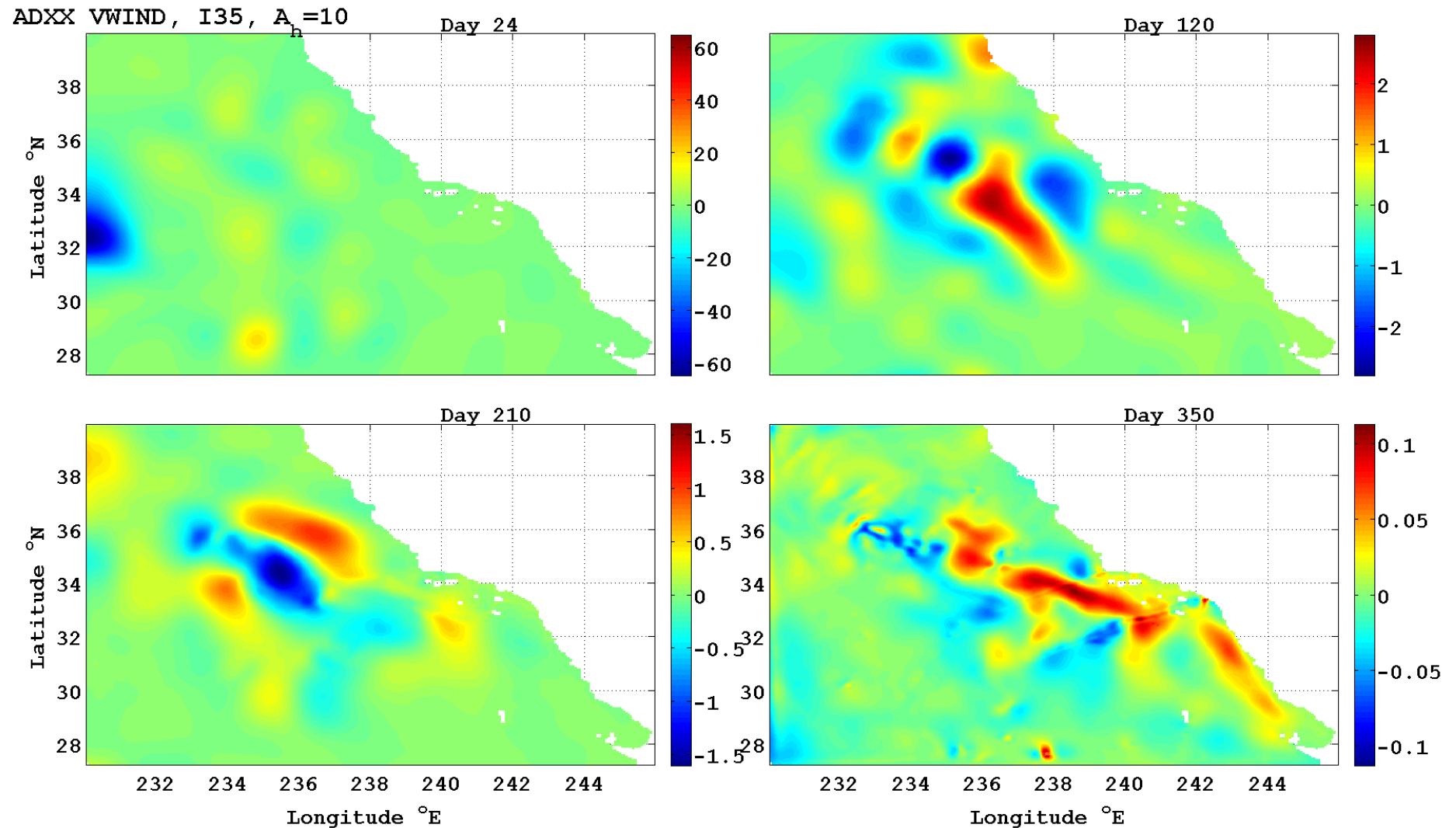
Stories from CASE

- Dealing with **exponential growth** of sensitivities
- **Conditioning controls** by approximating correlation
- Controlling the **open boundaries**
- Future stories -- i.e. wish list for code:
 - Packing routines and obcs I/O inefficient
 - Operators to provide temporal correlation information to controls
 - Additional cost terms
 - Integral observations (tomog, inverted echo sounders)
 - Additional control terms (i.e. “nuisance parameters”)
 - altimeter offset, large-scale observation bias, tomography navigation parameters
 - Balanced initialization (along with boundaries): Modal isopycnal displacement & spiciness

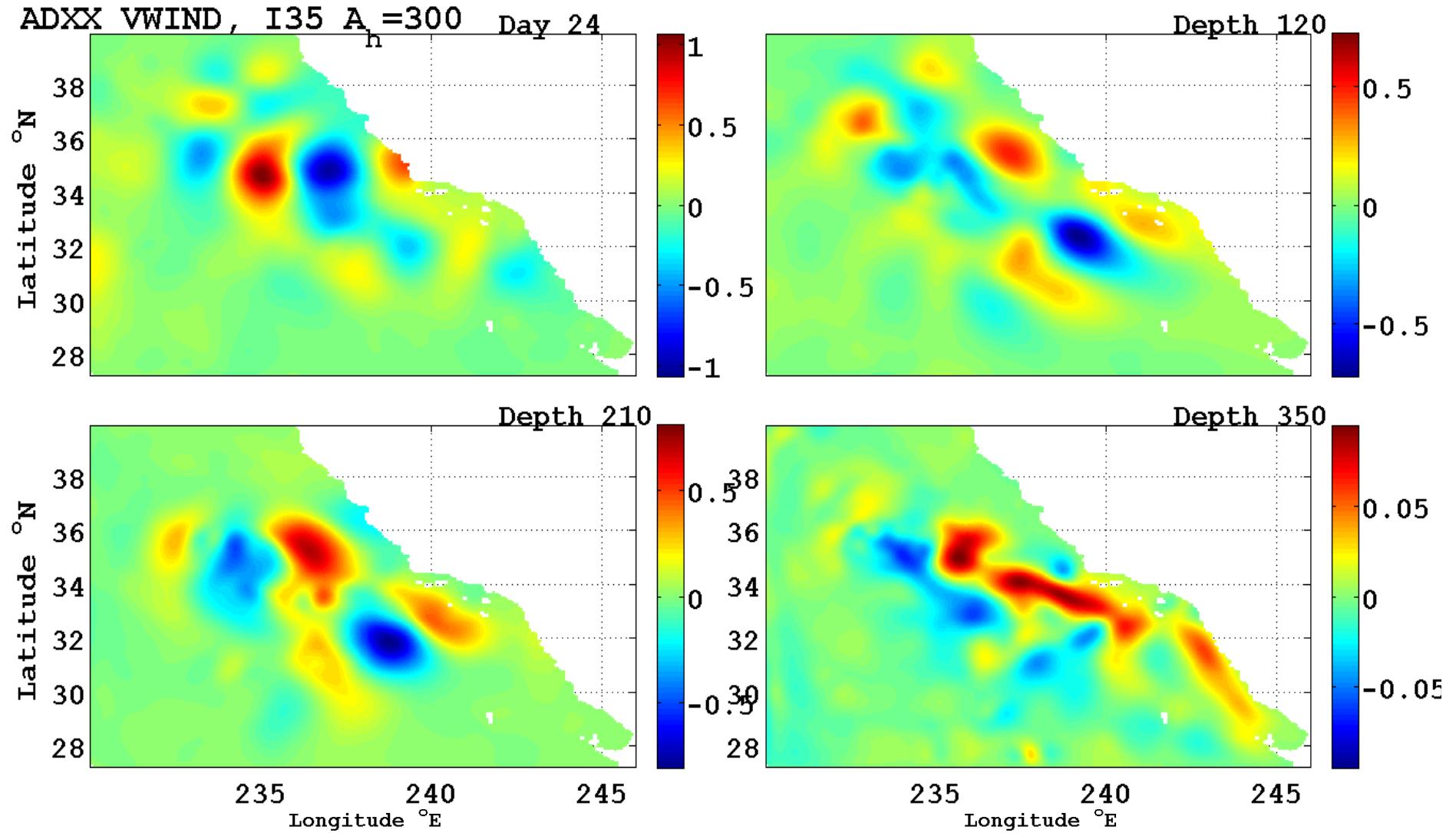
Spatial max., min., std., & avg. sensitivity to surface forcing (non-dimensionalized) as a function of time.
 Forward and adjoint model ran with horizontal harmonic viscosity = $10 \text{ m}^2/\text{s}$



Exponential sensitivity unusable

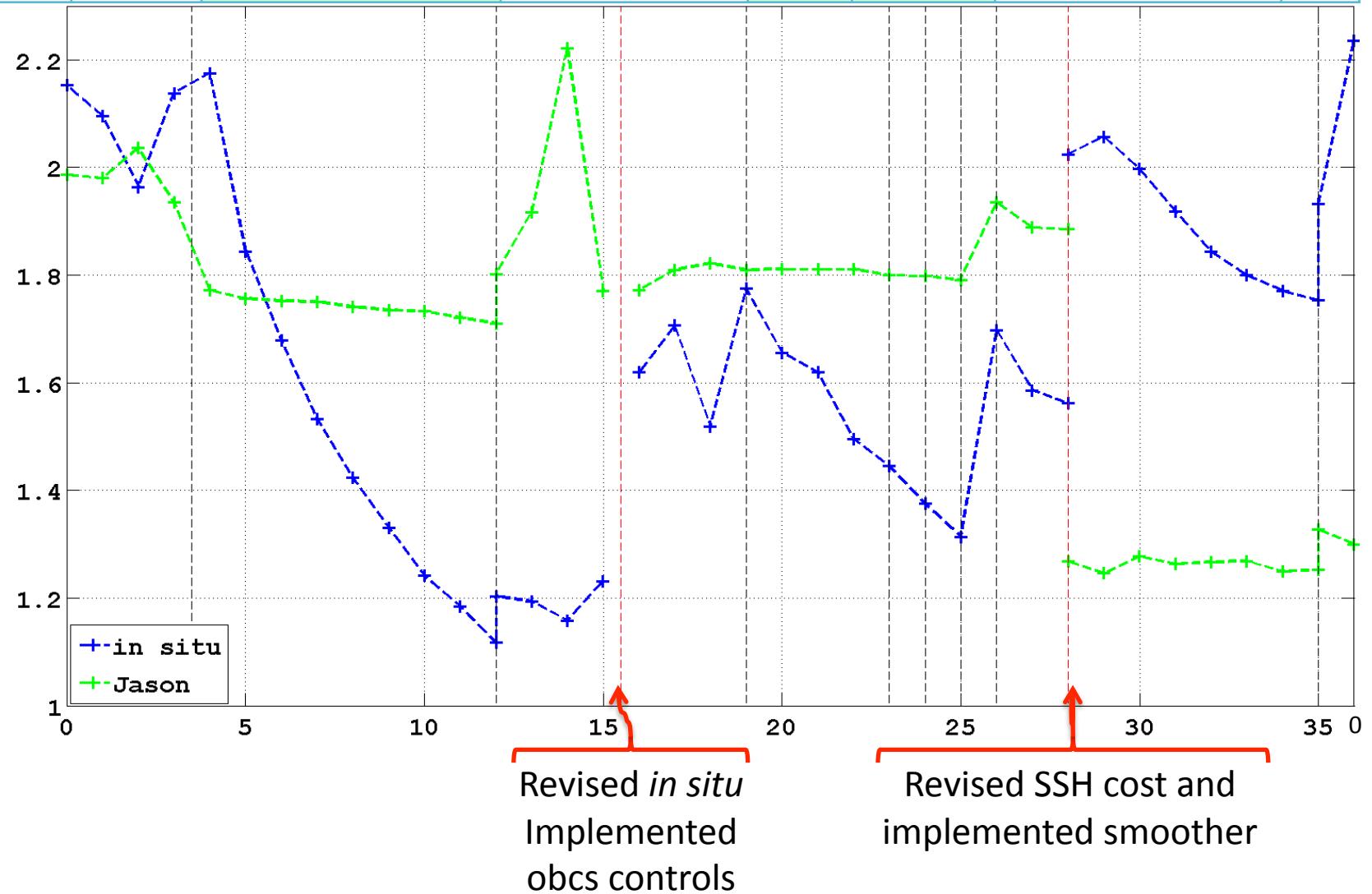


Exponential sensitivity unusable

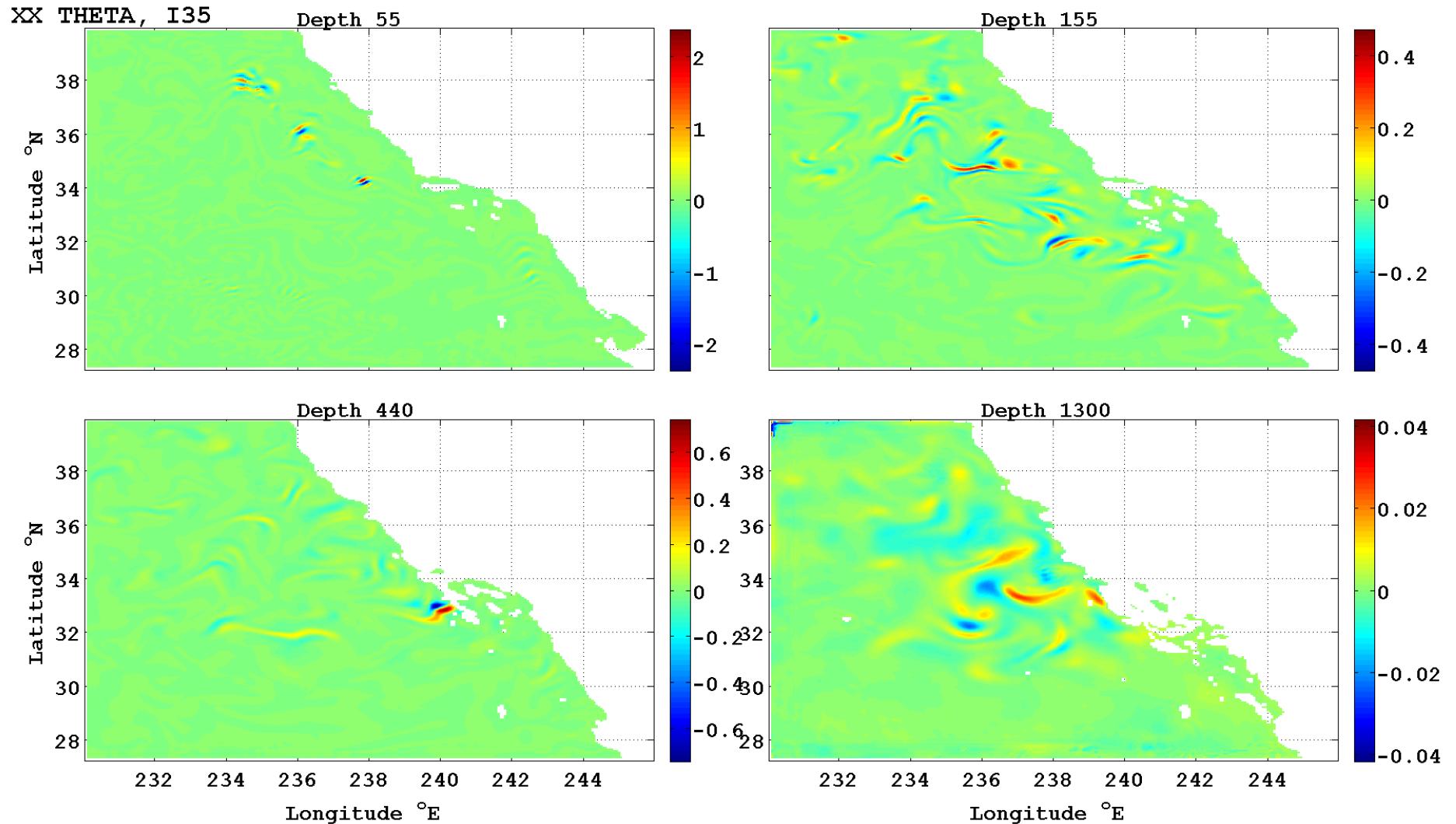


CASE: a bumpy road

A_h : Forward	10	1000	500	500	450 450 350 300	100	10
Adjoint	1000	1000	1000	500	450 350 300	100	??

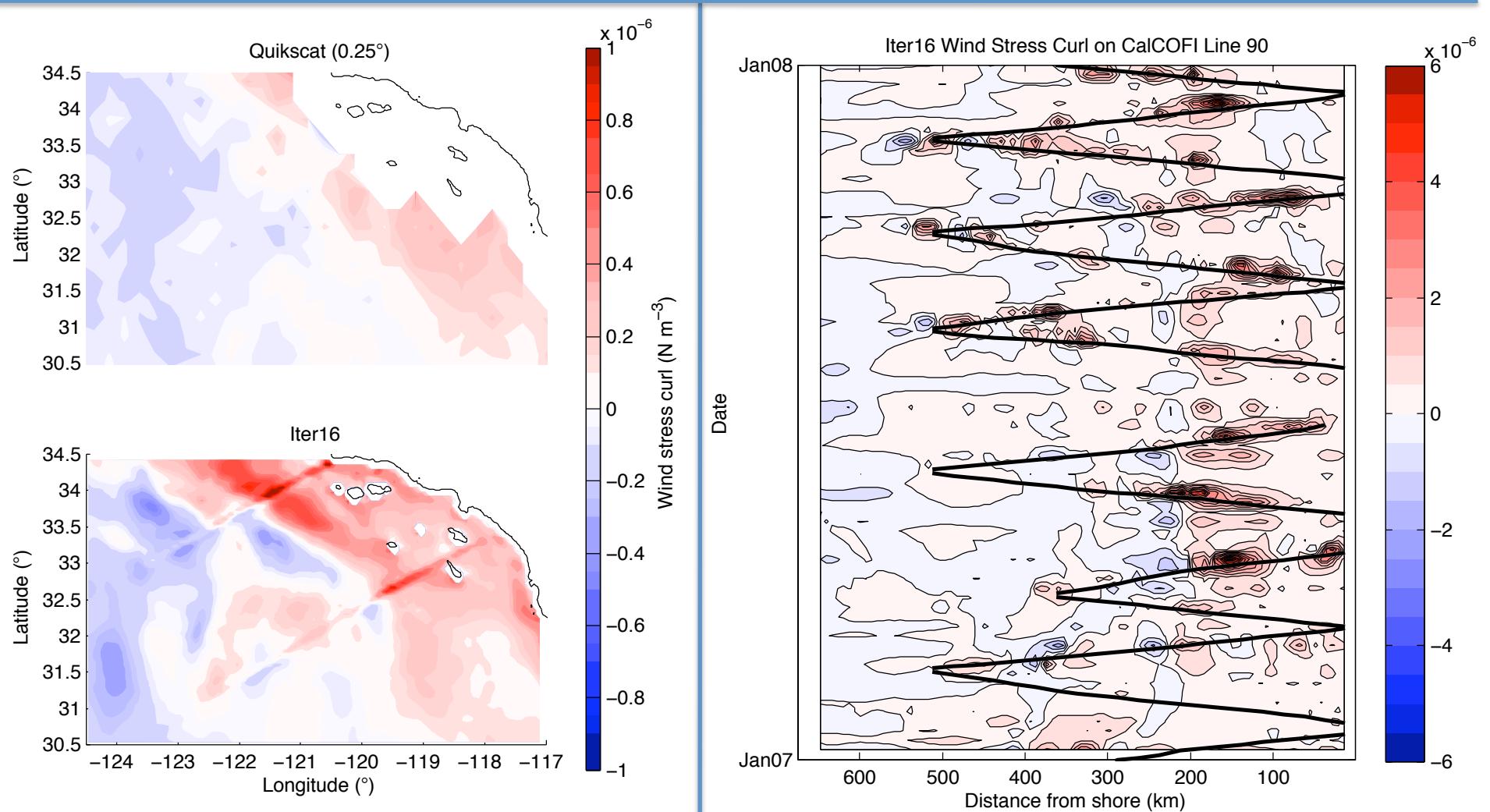


Iteration 35 controls – the damage is done...

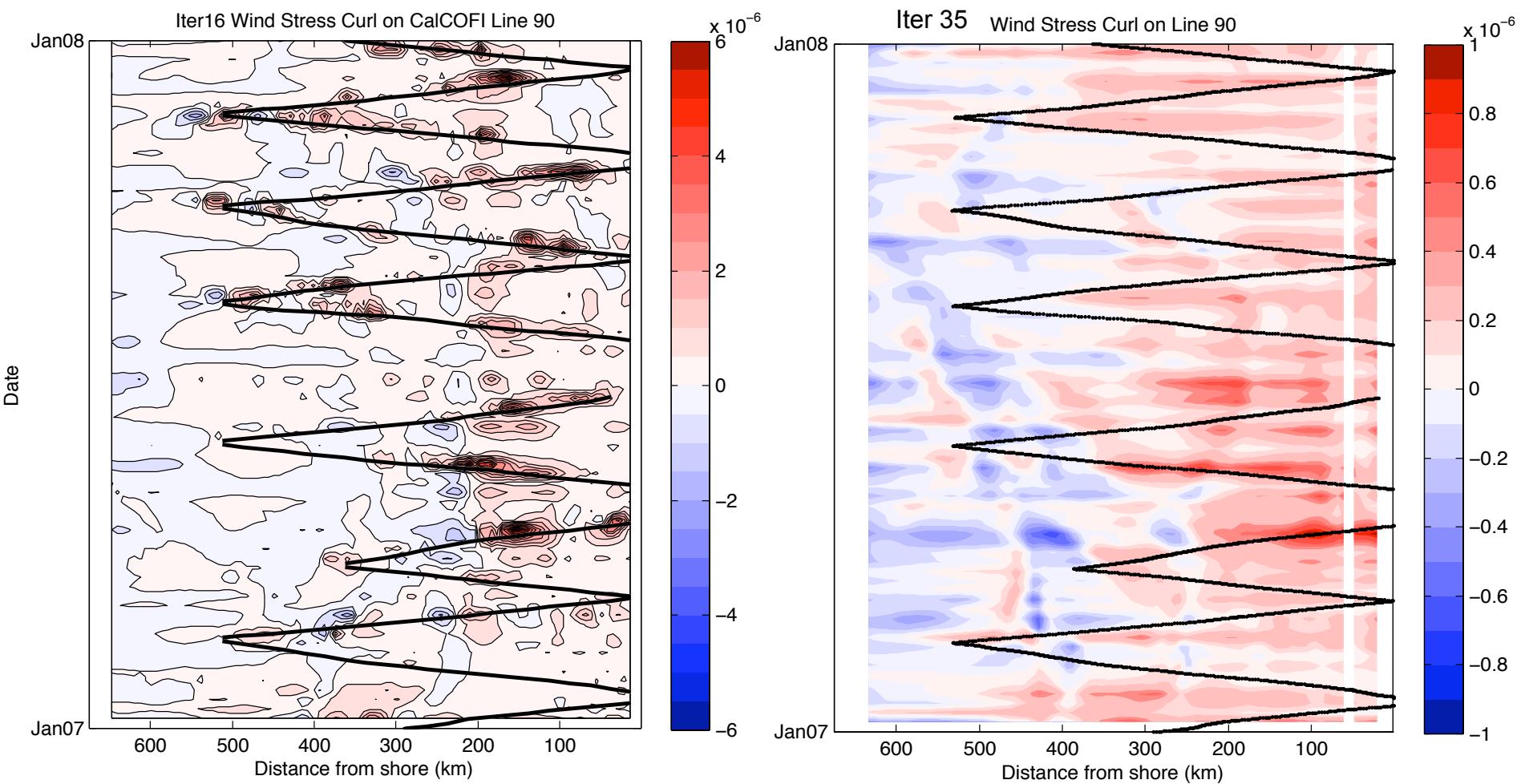


We are now “backstepping”: manually smoothing controls and running forward and adjoint models with $A_h = 300 \text{ m}^2/\text{s}$

Other issues – lack of correlation information

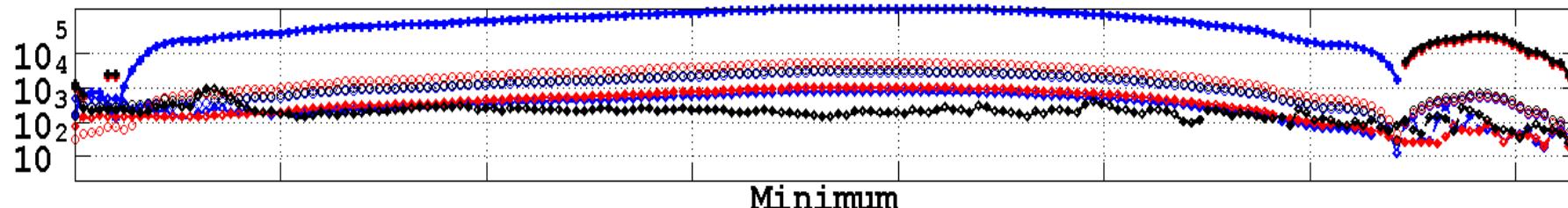


Other issues – lack of temporal correlation information

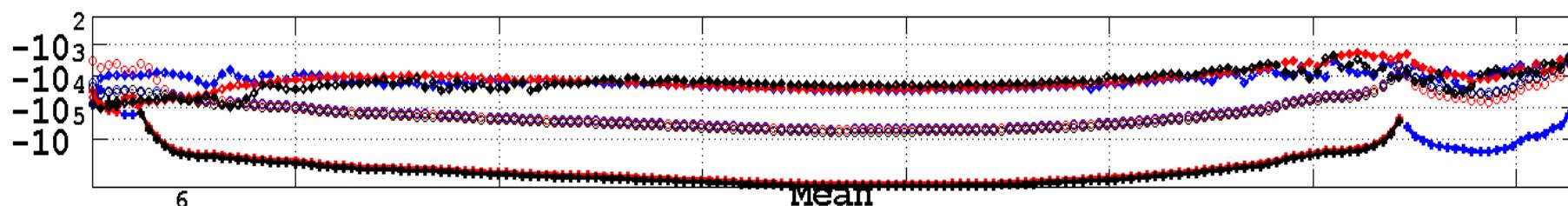


Regional dynamics – obcs very important
 Max, min, mean, and std. of modes of normal flow obc for
 Itertion 35 with $A_h = 300 \text{ m}^2/\text{s}$ – still finicky

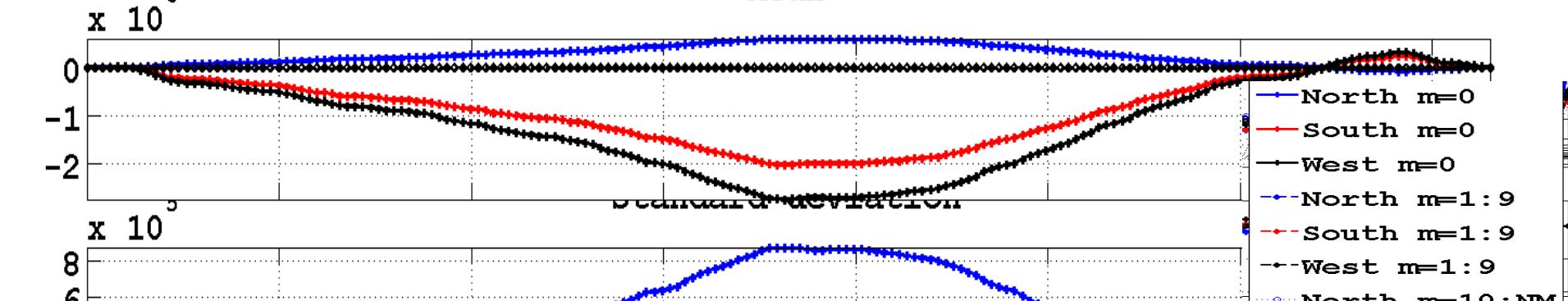
Maximum



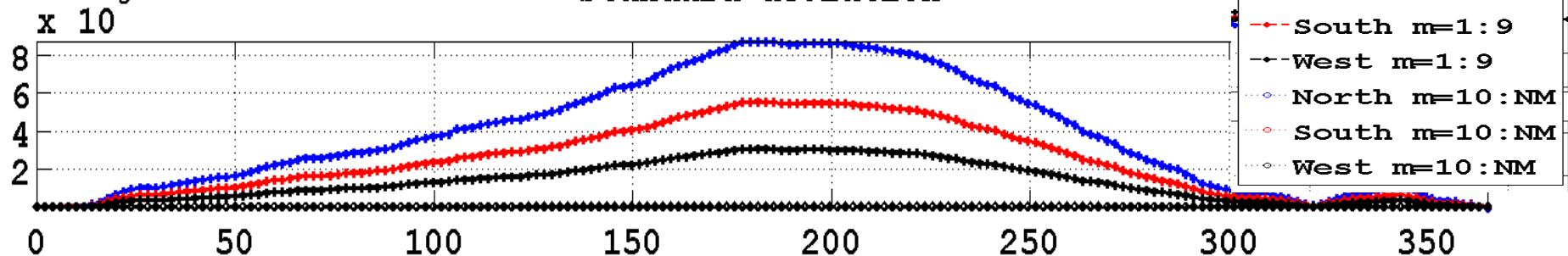
Minimum



Mean



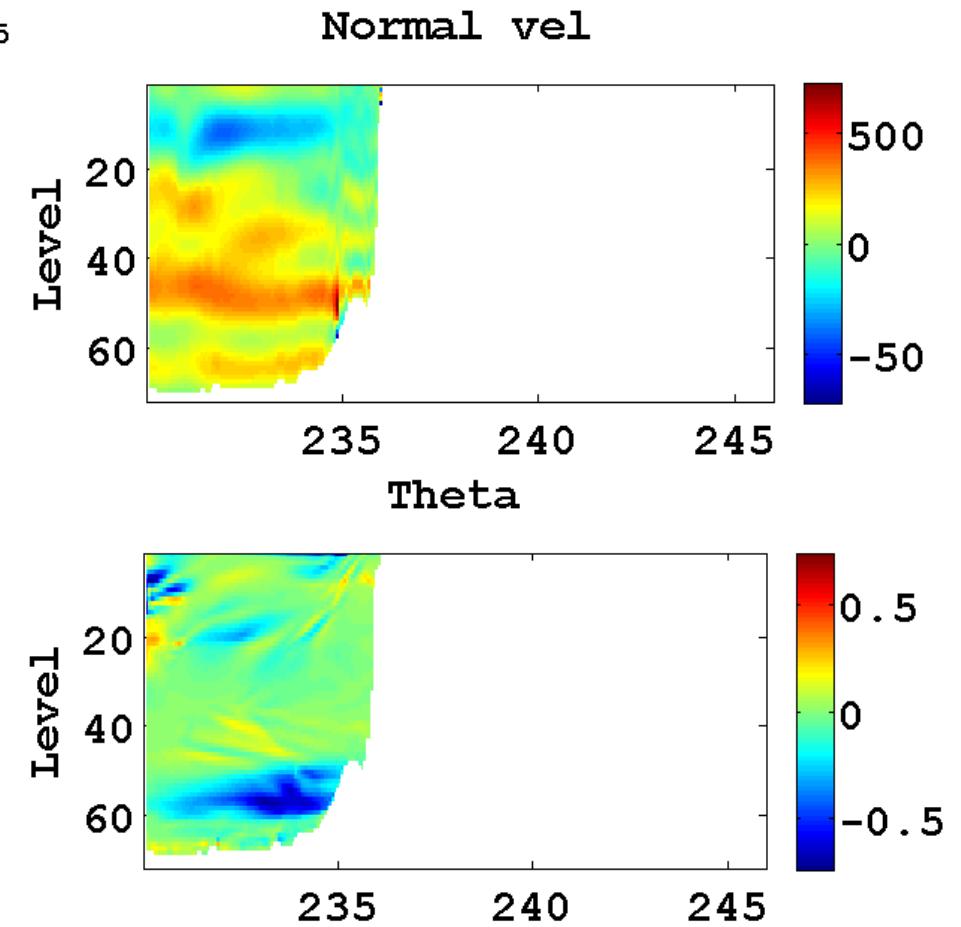
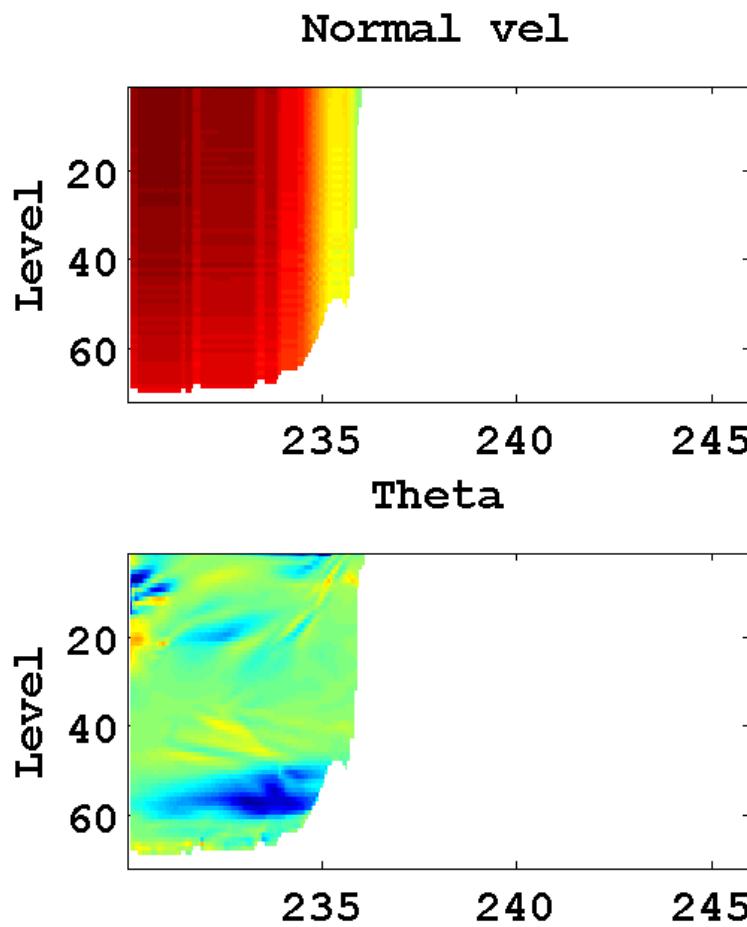
Standard deviation



- North m=0
- South m=0
- West m=0
- North m=1:9
- South m=1:9
- West m=1:9
- North m=10:NM
- South m=10:NM
- West m=10:NM

Gradient with respect to V & T northern boundary condition. Day 70, Iter 35, $A_h = 300\text{m}^2/\text{s}$

Only first 10 baroclinic modes of V



Controlling open boundary conditions

- Can condition gradients using modal decomposition
- Can ensure physical several ways.
 - E.g. Jake penalized departure from thermal wind
 - Here we penalize w^2 and choose: when within 10 grid points of an open boundary and deeper than 4000 m deep then penalize integrate w^2 at 1500 m. Weight set to 10^{-6} m/s.

- Lessons
 - Look at gradients whenever change set-up
 - Operator (smoother) necessary to provide control correlation information
 - Modal decomposition an effective way to condition controls
- Future stories -- i.e. wish list for code:
 - Packing routines and obcs I/O inefficient
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